DOCUME.T RESUME

ED 445 021 TM 031 626

AUTHOR Spector, J. Micha l
TITLE Toward a Philosopl v of Instructional Design.
PUB DATE 2000-04-28
NOTE 12p.; Paper presen ed at the Annual Meeting of the American Educational Researc n Association (New Orleans, LA, April 24-28, 2000).
PUB TYPE Opinion Papers (120 -- Speeches/Meeting Papers (150)
EDRS PRICE MF01/PC01 Plus Posta e.
DESCRIPTORS *Educational Philoso hy; Educational Theories; Elementary Secondary Education; *Instructional Design

ABSTRACT

What is the nature of nstructional design? Is instructional design merely the practical application of learning theories to learning situations? What elements form the build ng blocks of instructional design theory and research? What assumptions ab ut the nature of people and society are behind theories, principles, and prac tice? These questions arise naturally in the context of recent intern tional discussions about foundation issues in instructional design. This pape asserts that there is an identifiable landscape (context, perspecti es, issues, methods, and values) associated with instructional design. Key features of that landscape include assumptions about the nature of being a per on and living in society. Without such an identifiable landscape, there is little real possibility for progress in instructional design research. (Contains 38 references.) (Author/SLD)

Reproductions supplied by EDRS are the best that can be made
from the original document.

ED 445 021

TOWARD A PHILOSOPHY OF INSTRUCTIONAL DESIGN

J. Michael Spector
IDD&E, 330 Huntington Hall, Syracuse University, Syracuse, NY 13244
Spector@syr.edu

Paper Presentation for the Structural Learning and Intelligent Systems SIG
AERA 2000, New Orleans, 28 April 2000

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
☑ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

J. M. Spector

Abstract

What is the nature of instructional design? Is instructional design merely the practical application of learning theories to learning situations? What elements form the building blocks of instructional design theory and research? What assumptions about the nature of people and society are behind theories, principles, and practice? These questions arise naturally in the context of recent international discussions about foundation issues in instructional design. In this paper I argue that there is an identifiable landscape (context, perspectives, issues, methods, and values) associated with instructional design. Key features of that landscape include assumptions about the nature of being a person and living in society. Without such an identifiable landscape, there is little real possibility for progress in instructional design research.

Keywords: epistemology, instructional design, integrated perspectives, naturalism, ontology, phenomenology

TM031626

Introduction

At the beginning of a new century and millennium, it is quite common to reflect on the nature of one's life and to consider how things might change. This occurs with regard to professional circumstances as well as personal circumstances. Many instructional designers are inclined to such reflections and considerations. I had the pleasure to participate in two meetings in 1999 and a third one in 2000 in which the topic of the future of instructional design was the focus. The first occurred in March 1999 at Twente University in the Netherlands, organized by Sanne Dijkstra and partly sponsored by the Instructional Design Special Interest Group of the European Association for Research on

BEST COPY AVAILABLE

Learning and Instruction (EARLI) (Spector, 1999). The second was held in October 1999 at the University of Bergen in Norway (Spector & Anderson, in press). The third was held in New Orleans in April 2000 and was sponsored by the Structural Learning, Instructional Systems and Intelligent Tutors Special Interest Group of the American Education Research Association (AERA). All three meetings involved prominent instructional design researchers from Europe and North America. All were concerned with the impact of technology on our discipline. All included specific discussions concerned with epistemology and ontology. Several themes emerged from these meetings.

These meetings and the ongoing international dialogue within our professional community are in large part a result of sustained interest and sponsorship by the AERA Structural Learning, Instructional Systems, and Intelligent Tutors Special Interest Group, under Joe Scandura's leadership and John Durnin's role as editor of *The Journal of Structural Learning*, and the EARLI Instructional Design Special Interest Group, actively supported and led by a number of European scholars, including Sanne Dijkstra, Jeroen van Merriënboer, and Begoña Gros. We owe them our thanks for helping sustain these very meaningful and provocative discussions.

There appears to be renewed interest in foundation issues, especially with regard to philosophical foundations. There is clear interest in how to support learning in and about complex domains. There is renewed interest in integrated and holistic perspectives of instructional design and as well as of learning (the emphasis on the latter in the constructivist literature is perhaps more well known). Finally, there is a concern that in order to make progress it is vital to conduct experiments and establish viable links between - and not merely encouraging words about - theory and practice.

The purpose of this short essay is to explore the landscape of such concerns in the form of a set of First Principles for Instructional Design. These might become the basis for further debate and discussion that could eventually lead to a well elaborated philosophy of instruction. That is my hope. If I manage to continue the discussions already underway and provoke them a bit more, then I shall count this effort a success. I realize that much work along these lines has already been done, most obvious in two volumes edited by Reigeluth (1983, 1999). There is much yet to be done.

In this paper, I continue to explore the meaning of instructional design in the context of advances in cognitive science and information technologies. I proceed on the basis of a few simple assumptions and definitions. First, I view instruction as that which facilitates and supports learning. Further, instructional facilitation and supports are generally planned and may be more or less effective, depending on a wide variety of circumstances. Exploration of those factors and circumstances which appear to be effective in supporting and facilitating learning is a central activity and primary concern for instructional design research. I assume that these activities remain critically important to society although there have been apparent shifts in how instructional design activities are conducted and evaluated.

Reigeluth (1999) put it somewhat differently, arguing that instructional design research aims to improve how people learn and develop. Reigeluth (1999) argues that instructional design theories are design oriented and offer probabilistic (as opposed to deterministic) methods to increase the possibility of attaining learning goals. Reigeluth's view implies the possibility of progress, as does my own. However, Reigeluth's recent

volume contains so many theories and perspectives that it might lead a reader to conclude that there is no well established paradigm for instructional design research or that any view is as good as or as defensible as any other. The temptation might then be to "gather what one has learned from coincidence and keep on keeping-on" (to paraphrase Bob Dylan). I believe such a conclusion is wrong-headed, and I doubt that this is what Reigeluth had in mind when putting together that impressive second volume of instructional design theories.

However, given the rapidly changing technology context, the shift towards more problem- and case-based approaches, more emphasis on and interest in qualitative research, and the increase in the number of instructional design theories, it seems appropriate to ask once again what the nature of instructional design is and what a philosophy of instructional design would be like. These are the tasks I undertake in this paper. That my conclusions are tentative is reflected by the question mark in the title.

Philosophical Foundations

As a result of those recent discussions concerning philosophy and technology and the future of instructional design, I have revisited my own thinking with regard to philosophy and instructional design (see Spector, 1994, 1995), and I, too, have begun to wonder what it all means. Notice that word 'all'. Some have argued that it is just such words that indicate the introduction of a philosophical topic. Indeed, this pattern of thinking can be traced back to classical Greek philosophy. One representation of Plato's thinking, especially in his middle dialogues, involves the following pattern of reasoning.

Assumption: Things that are properly called by the same name share a common attribute.
Investigative Query: What do all X's share in common? What is the ultimate nature of X? What is the meaning of X?
Tentative Response: All X's share Y in common.
Tentative Hypothesis: Z also shares attribute Y. Therefore, Z is an X.

Of course, Plato's way of reasoning immediately led to such concerns as these:

Skeptical Inquiry: Do all X's share or exhibit Y? What is the nature of X_n?
Infinite Regression Complaint: If all X's share Y, then that which all X's and Y have in common is a new thing, which could be called Y-PRIME. And, that which all X's, Y, and Y-PRIME have in common could be called Y-PRIME-PRIME. And, because our imaginations are not so limited, that which ... well, the remainder of this pattern of reasoning is left as an exercise to be completed by the reader.
Subjective Complaint: Whether or not one is inclined to conclude that X_n shares Y depends on a perceiver's particular circumstances, and not all circumstances are the same nor are all perceivers the same.
Deconstructive Complaint: There is no reason to believe that all of anything shares any attribute; it is wrongheaded to think that there are ultimate meanings.

Reconstructive Consideration: People naturally seem inclined to construct representations of meaning and meaningfulness, and many of these representations are shareable and in fact shared.

Philosophy is especially interested in the use of just those innocent-looking, little words we tend to ignore: 'is', 'all', 'if' and so on. In one sense, focusing on the uses and nuances associated with such words gives philosophy the appearance of being thought in slow motion, a characterization I find both descriptive and meaningful. However, in this context, I want to focus on the philosophical enterprise as essentially and fundamentally concerned with the bounds of sense. A central activity in any philosophical enterprise, then, is an attempt to distinguish sense from nonsense - to determine the limits of reason, to distinguish that which is meaningful from that which is not. Such an activity need not presume that this task can be accomplished once and for all. Indeed, a common philosophical attitude is that this task must be continually revisited on account of discoveries, changing ideas, and so on. If the price of freedom is constant vigilance, then one might say that the price of understanding is constant investigation.

Apparently Socrates exhibited just such an attitude (willingness to re-examine assumptions as well as conclusions) in the course of investigating various ethical positions, including his own. Inherent in a skeptical (i.e., healthy) attitude with regard to such investigations is the notion that it would be a remarkable coincidence if the limits to one's imagination happened to coincide with the limits to reality. Conclusions about the big issues (such as how memory works, how different people learn different things, and so on) should be tentative and treated with the uncertainty they are due. This is perhaps enough of a background on philosophy. It should be obvious that I value a skeptical attitude, and I regard epistemology as a central philosophical activity, in contrast with the traditional emphasis on ontology. I suppose my biases and perspective are sufficiently clear at this point.

What is it like to have a skeptical attitude and to explore foundational issues in epistemology? These are two different questions and they are elaborated in much detail in various places in the philosophical literature. The skeptic's attitude is primarily a questioning attitude. Questioning is all too easily confused with challenging. An elaboration of a questioning or searching attitude can be found in Sextus Empiricus' *Outlines of Pyrrhonism* - the classical work on skepticism. The two most well known philosophical skeptics are Socrates, as represented in Plato's early dialogues, and Wittgenstein, as represented in his later works. My summary of skepticism is intended to be consistent with their views and involves the following principles:

S1: Having a question is essential to the skeptic's position. Many people who ask questions do not have questions (they might be called rhetoricians or politicians). Putting a statement into the grammatical form of a question is different from being occupied with trying to determine something that one does not know or understand. It is the latter who are skeptics, and this fits the early Greek meaning of a skeptic as one who inquires.

S2: A skeptic might be inquiring into a position advanced by someone else or into one's own position. The basic situation involves an attempt to provide an answer or an explanation to a situation or problem that is not acceptably understood by

one or more of those involved in the inquiry. In short, having a question assumes a person troubled by the lack of an adequate explanation.

S3: Conclusions that are reached along the way are subject to reconsideration and should be held with appropriate degrees of probability and uncertainty.

S4: When it comes to what one might relinquish when caught in a quandary, we ought to recognize the primacy of perception and direct experiences over derived conceptual frameworks, although concepts shape how we talk about, recall and re-construct experience.

What is it like to conduct epistemological investigations? Traditionally, epistemology has been concerned with the sources and foundations of knowledge. Traditional distinctions have involved certainty (the domain of knowledge) and probability (the domain of belief). Traditional core issues involved theories of truth (coherence versus correspondence) and determinants of meaning (external versus internal). Times do indeed change - one can hardly ever step into the same conceptual confusion even once these days, since saying something is the same implies persistence over time and through change. Nevertheless, the modern epistemological enterprise proceeds with such principles as these:

E1: Context and use are primary determinants of meaning. As context and use vary, it is likely that meaning will also change.

E2: Relevant contexts typically include other inquirers and interlocutors with whom one might exchange ideas, questions, tentative conclusions, and so on.

E3: The commercial theory of truth (truth is what people accept or have been sold) is at least as problematic as the coherence theory of truth (truth is what fits best with other well-established views) or the correspondence theory of truth (truth is that which fits objective circumstances best).

E4: When it comes to resolving questions of meaning, what others say and do is often relevant; determining what others say and do, especially when not influenced directly by those who might bias outcomes, is fundamental to establishing points of reference and interpreting various situations.

There are obvious relations among these principles although they are derived from different sources. For example, E4 is directly connected with S3 and S4; S1 and S2 are clearly connected to E1 and E2. I would like to consider these eight principles as the rules for engagement in epistemological investigation. I realize that others will develop different principles, and differences in such starting points is worth discussion. For now, I hope that these are acceptable for getting underway. I shall next indicate how these principles might be played out in the course of establishing a framework for examining the domain of instructional design. I shall not further defend my "pieces of eight". I do acknowledge that there are two other philosophical domains, ontology and ethics, which are also directly relevant to instructional design. Ontology is relevant since many instructional designers argue (for good reason and with good evidence) that there is a connection between the kind of subject and the instructional strategy likely to support learning about that subject. This implies an investigation into the kinds of things about which one might teach, and therefore into the kinds of things that exist (see, Merrill,1993,

for example). Likewise, ethical issues (such as conflicts of interest, copyrights, intellectual property rights, social responsibility, etc.) arise with regard to the professional practice of instructional design, as recognized by the International Board of Standards for Training, Performance and Instruction (***ibstpi***) (see Richey and Fields, 2000, for example). I choose not to address those issues here as the discussion would become much too lengthy.

Philosophical Framework for Instructional Design

The key terms that I adopt are 'instruction', 'learning', 'knowledge' and 'philosophy' and I use them in the following way. Instruction is that which supports or facilitates learning. This implies that the kind of learning that is of interest is planned or intentional learning, which involves a goal of some kind. Learning essentially involves a change in abilities, attitudes, beliefs, capabilities, knowledge, mental models, patterns of interaction or skills. These changes may be localized within an individual, a group of individuals, an organization, or perhaps even a society. To be properly called learning, such changes should tend to persist over time and across a variety of distractions. The fact that changes have occurred should be either directly or indirectly observable. I shall call this definition the Learning Principle (L), since it might be challenged by some, and it is possible to investigate its implications for the design of instruction.

This principle is linked most directly to S1 (having a question involves inquiring activity) and S2 (learning involving searching for a resolution to an unsettled state). How persistent changes might be can be linked to S3 and E3. The process of finding satisfactory resolutions can be linked to E4. In short, the instructional principles provided in this section can be linked in various ways to the philosophical foundations presented earlier. Making these links explicit will inform the elaboration of the foundations (perhaps adding, altering or eliminating foundation principles) and help identify appropriate theoretical considerations.

Much of the instructional design literature is devoted to distinguishing among the kinds of things that can be learned and the kinds of changes that can occur. Pursuit of an emphasis on the different kinds of things to be learned or tasks to be performed places ontology in the forefront, which is entirely acceptable and represents a strong tradition within instructional design (Dijsktra, 1997, 1999; Gagné, 1985, 1995; Merrill, 1993; Scandura, 1982, 1995). Indeed, it well worth pursuing the articulation of the ontological and epistemological perspectives with regard to instructional design, but that is beyond the scope of this article.

The list of things which might change on account of a learning experience (abilities, attitudes, and so on) is intentionally long and intended to be broad. The items in this list are drawn from two learning metaphors presented by Sfard (1998): learning as the acquisition of knowledge and expertise (see Ericsson & Smith, 1991; Anderson, 1982), and learning as participating in a community of practice (Brown, Collins, & Duguid, 1989; Resnick, 1989; Wenger, 1999). She argues that there is a place for both perspectives. The view that these two broad perspectives are intertwined constitutes what I call an integrated perspective (this also forms the basis for the Integration Principle discussed below; see Spector, 1994, 1995).

As already noted, philosophers have historically differentiated knowledge from belief. Knowledge was historically reserved for those things about which we could be certain (such as the conclusions of valid mathematical proofs). Beliefs, then, were only more or less probable and likely to be subject to much change and instability. This use does not fit common usage very well and is no longer the only acceptable philosophical view. Indeed, the more modern notion is that we build up our knowledge in stages, in bits and pieces. This perspective is generally regarded as a kind of naturalistic epistemology in contrast to the rational epistemology that has dominated the history of philosophy. Naturalistic epistemology found its way into educational research through the works of Dewey (1916), Piaget (1937, 1970) and Vygotsky (1962, 1978).

These philosophers of education examined the development of human thinking in its many and varied natural settings. In short, it is modern educational researchers who have taken the empiricist imperative - human experience must be the starting point for understanding - to heart. This natural and close connection to experience, both from a design perspective and from a learning perspective, provides the starting point for a philosophy of instruction. This principle can be traced directly to S4. I call this starting point the Experience Principle (E): understanding begins in and is based upon human experience. This principle has clear and specific implications for design as well as for learning and assessment of outcomes. The arbiter of what works in instruction is not good intentions or high ideals but a careful and continuous assessment of outcomes and attempts to link observable effects to underlying causes. The methods that we use to establish what works are now likely to involve action research (Argyris, Putnam & Smith, 1985; Lewin, 1947) and activity theory (Leont'ev, 1974: Nardi, 1996), which reflect links to S4 and E4.

Gagné and Merrill (1990) published a landmark article that recognized an important theme and trend that is more typically associated with constructivists (e.g., Duffy & Jonassen, 1992; Jonassen, 1992) and advocates of situated learning (e.g., Lave, 1988). The theme in that paper is that the proper object of instruction is most typically and most often an integrated and purposeful human activity - an enterprise. Of course this theme is not new. It can be traced back to earlier research, such as Piaget's (1937, 1970) work concerning the experiential setting in which children developed understanding and Vygotsky's (1962, 1978) examination of the social context in which conceptual understanding developed. A broad expression of this notion is the Context Principle (C): Context is relevant for learning and the construction of meaning. Therefore, context must be taken into explicit consideration when planning instruction. This principle has direct links to E1 and E2.

Most instructional designers accept some version of the Context Principle either explicitly or tacitly. Instructional designers, in other words, do have at least an implicit philosophy of instructional design and that philosophy is related to identifiable philosophical principles (such as might be found in the literature on naturalistic epistemology, pragmatism, and so on). Differences involve what might be considered a relevant context. For example, relevant to mastery of a step in a procedure might be an understanding of the general purpose for the whole procedure and a general view of how it is performed. This is why scenario-based and situated approaches have long been used in training complex technical skills (Dijsktra, 1997; van Merriënboer & Dijkstra, 1997).

Closely associated with the Context Principle and one that has been explicitly addressed by many instructional design researchers (Duffy & Jonassen, 1992; Gagné & Merrill, 1990; Merrill, 1993; Spector, 1994, 1995) is what I shall call the Integration Principle (I): human experience does not come neatly compartmentalized. It must be considered and understood in the context of a setting that typically includes the following: other individuals, a variety of goals (some of which might not be explicit and might conflict with others), various artifacts and technologies, activities, and cultural, organizational and societal influences. This principle can be linked back to the S1 and S2 as well as E1 and E2.

One implication of the Integration Principle is that broad and multiple approaches to learning and instruction are likely to be appropriate (see Sfard, 1998, for example). A second implication is that many of the distinctions that instructional designers have been inclined to make over the years are not necessarily helpful in designing, facilitating or evaluating learning. Goodyear (in press), for example, argues that the following recurring distinctions can lead us to adopt exaggerated positions and forget that the starting and ending point should be human experience:

Knowledge	**Skill**
Knowing that	Knowing how
Understanding	Doing
Academic knowledge	Practical knowledge
Declarative knowledge	Procedural knowledge
Explicit (articulate) knowledge	Tacit knowledge
Discursive consciousness	Practical consciousness
Theory	**Practice**

Figure 1. Recurring distinctions questioned by Goodyear.

The Integration Principle has implications for design as well. As van Merriënboer and Dijsktra (1997) argue, whole task activities are more likely to be supportive of learning than part task activities (they identify exceptions to this, of course, such as when particular sub-skills must be practiced in order to acquire automatic performance). The most common distinction between declarative and procedural knowledge is called into question by this principle. Most typically, human activities involve both kinds of knowledge and completely separate treatment in an instructional sequence is therefore likely to be sub-optimal. A background principle often cited by designers is that people will learn what they do. What people most typically do is apply both declarative and procedural knowledge to accomplish a particular task. Therefore, it is worth designing instruction to include both types of knowledge brought to bear in an explicit fashion in a learning activity.

The final principle that I would like to propose for this initial set of principles is the Uncertainty Principle (U). Basically, this principle is a reminder that the instructional enterprise of instructional is complex and our knowledge of relevant aspects is

BEST COPY AVAILABLE

incomplete. We do not know in a complete or comprehensive all of the factors and mechanisms involved in learning. Educational research in general produces provisional and tentative conclusions. This principle has direct and clear links to both S3 and E3. If one adopts Reigeluth's (1983) view that instructional design is primarily a prescriptive enterprise aimed at a set of principles to be used to guide the development of optimal learning solutions, then instructional research is fundamentally about what works best in various situations and circumstances. While we are inclined to generalize findings, we should realize that there are inherent limits to the generality and certainty of our findings. In short, we may know less about learning and instruction than we are inclined to believe.

Concluding Remarks: A First Set of Principles

I have presented a rough sketch to support a set of five basic principles to consider as a foundation for a philosophy of instruction. There are as follows:

- Learning Principle (L) - learning is fundamentally about change.
- Experience Principle (E) - experience is the starting point for understanding.
- Context Principle (C)- context determines meaning.
- Integration Principle (I) - relevant contexts are broad and multi-faceted.
- Uncertainty Principle (U) - we know less than we are inclined to believe.

Whether or not such principles are useful for the design of instruction or have any observable impact on learning outcomes is perhaps worth some discussion. I do not know if such principles are useful but I do believe that some first principles are worth discussing. The instructional community has been through a period of unnecessarily divisive debate. We have seen new technologies emerge and a great deal of enthusiasm for the potential of new approaches and new technologies. Many exemplary projects exist to illustrate what is possible. However, there is still far too little research being done to establish links between instructional design methods and sustainable learning outcomes. Studies to replicate previous research are quite rare. In my opinion, the instructional design research community is in jeopardy of losing its scientific underpinnings. Some may celebrate this as a long overdue outcome; I would regard it as a serious loss.

References

Anderson, J. R. (1982). Acquisition of cognitive skill. *Psychological Review, 89*, 369 - 406.

Argyris, C., Putnam, R.,& Smith, D.. (1985). *Action Science: Concepts, Methods and Skills for Research and Intervention*. San Francisco, CA: Jossey-Bass.

Brown, J. S., Collins, S., & Duguid, D. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*, 32-42.

Dewey, J. (1916). *Democracy and education: An introduction to the philosophy of education*. New York: Macmillan.

Dijkstra, S., & Van Merriënboer, J. J. G. (1997). Plans, procedures, and theories to solve instructional design problems. In S. Dijkstra, N. Seel, F. Schott & R. D. Tennyson

(Eds), *Instructional design: international perspectives, Volume 2*, 23 – 43. Mahwah, NJ: Erlbaum.

Dijkstra, S. (1997). The integration of instructional systems design models and constructivistic design principles. *Instructional Science, 25*, 1-13.

Dijkstra, S. (1999). Instructional design for the development of knowledge and the learning of skills. In Schulz, W. K. *Aspekte und Probleme der didaktischen Wissensstrukturierung*. [How to structure knowledge for the purpose of instructional design]. Frankfurt am Main: Peter Lang.

Duffy, T. M., & Jonassen, D.H. (Eds.) (1992). *Constructivism and the technology of instruction: A conversation*. Hillsdale, NJ: Erlbaum.

Ericsson, K. A., & Smith, J. (Eds.) (1991). *Toward a general theory of expertise: Prospects and limits*. New York: Cambridge University Press.

Gagné, R. M. (1985). *Conditions of learning* (4th Ed.). New York: Holt, Rinehart, and Winston.

Gagné, R. M. (1995). Learning processes and instruction. *Training Research Journal* 1: 17-28.

Gagné, R. M., & Merrill, M. D. (1990). Integrative goals for instructional design. *Educational Technology Research and Development, 38*(1), 23-30.

Goodyear, P. (in press). Environments for lifelong learning: Ergonomics, architecture and educational design. In J. M. Spector & T. M. Anderson (Eds.), *Integrated and holistic perspectives on learning, instruction and technology* (pp. 1-18). Dordrecht: Kluwer Academic Press.

Jonassen, D. H. (1992). Objectivism versus Constructivism: Do We Need a New Philosophical Paradigm. *Eductational Technology: Research and Development*, 39, 5 -14.

Lave, J. (1988). *Cognition in Practice: Mind, mathematics, and culture in everyday life*. Cambridge, UK: Cambridge University Press.

Lewin, K. (1947). Frontiers in Group Dynamics. *Human Relations, 1* (1), pp. 5-41.

Leont'ev, A. (1974). The problem of activity in psychology. *Soviet Psychology, 13*(2), 4-33.

Merrill, M. D. (1993). An integrated model for automating instructional design and delivery. In J. M. Spector, M. C. Polson, & D. J. Muraida (Eds.), *Automating instructional design: Concepts and issues*. Englewood Cliffs, NJ: Educational Technology.

Nardi, B. (Ed.) (1996). *Context and consciousness: Activity theory and human-computer interaction*. Cambridge, MA: MIT Press.

Piaget, J. (1937). *La construction du réel chez l'enfant*. [The child's construction of the reality]. Neuchâtel: Delachaux et Niestlé.

Piaget, J. (1970). *Epistémologie génétique*. [Genetic epistemology]. Paris: Presses Universitaires de France.

Reigeluth, C. M. (Ed.) (1983). *Instructional-design theories and models: An overview of their current status*. Hillsdale, NJ: Erlbaum.

Reigeluth, C. M. (Ed.) (1999). *Instructional-design theories and models: A new paradigm of instructional theory, Volume II*. Mahwah, MJ: Erlbaum.

Resnick, L. B. (Ed.) (1989). *Knowing, learning, and instruction*. Hillsdale, NJ: Erlbaum.

Richey, R.C. & Fields, D.F. (Eds.) (2000) *Instructional design competencies: The standards (3rd Ed.)*. Syracuse, NY: ERIC Clearinghouse on Information and Technology & The International Board of Standards for Training, Performance & Instruction.

Scandura, J. M. (1982). Structural (cognitive) task analysis: A method for analyzing content. *Journal of Structual Learning, 7*, 101-114.

Scandura, J. M. (1995). Theoretical foundations of instruction: Past, present and future. *Journal of Structural Learning, 12*, 231-243.

Sextus Empiricus (1933). *Outlines of Pyrrhonism*. (Loeb Classical Library, translated by R. G. Bury). Cambridge, MA: Harvard University Press.

Sfard, A. (1998). On two metaphors for learning and the dangers of choosing just one. *Educational Research, 27*(2), 4-12.

Spector, J. M. (1994). Integrating instructional science, learning theory and technology. In R. D. Tennyson (Ed.), *Automating instructional design, development, and delivery*. Berlin: Springer-Verlag.

Spector, J. M. (1995). Integrating and humanizing the process of automating instructional design. In R. D. Tennyson & A. Barron (Eds.), *Automating instructional design: Computer-based development and delivery tools* (pp. 523-546). Brussels, Belgium: Springer-Verlag.

Spector, J. M. (1999, March). *Philosophical implications for the design of instruction about complex systems*. Invited presentation at the conference on epistemology, psychology and instruction sponsored by the University of Twente and the EARLI Instructional Design Special Interest Group. Enschede, The Netherlands: University of Twente.

Spector, J. M., & Anderson, T. M. (Eds.) (in press). *Integrated and holistic perspectives on learning, instruction and technology*. Dordrecht: Kluwer Academic Press.

Spector, J. M., Arnold, E. M., & Wilson A. S. (1996). A Turing test for automatically generated instruction. *Journal of Structural Learning*, 12(4), 310-313.

van Merriënboer, J. J. G., & Dijkstra, S. (1997). The four-component instructional-design model for training complex cognitive skills. In Tennyson, R. D., Schott, F., Seel, N. & Dijkstra, S. (Eds). *Instructional design: international perspectives, Volume 1* (pp. 427-446). Mahwah, NJ: Lawrence Erlbaum.

Vygotsky, L. S. (1962). *Thought and language*. (Edited and translated by E. Hanfmann & G. Vakar). Cambridge, MA: MIT Press.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. (M. Cole, V. John-Steiner, S. Scribner & E.Souberman, Editors and Translators). Cambridge, MA: Harvard University Press.

Wenger, E. (1999). *Communities of practice: Learning, meaning and identity*. Cambridge: Cambridge University Press.